

**Assessment of Regional Water Quality Treatment by  
Proposed NTS Facilities Serving  
Selected Development Planning Areas in the City of Irvine and the  
El Toro Great Parks Re-Development Areas**

*Prepared for*

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**April 8, 2004**

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# 1 Introduction

This report describes an assessment of certain proposed regional water quality treatment capabilities of the proposed Natural Treatment System (NTS) facilities. The purpose was to evaluate the extent to which NTS facilities serving certain proposed development projects in the City of Irvine Planning Areas (PA) 1, 6, 18, 39 and the El Toro Reuse Area (hereinafter referred to as the Irvine Development Areas) would satisfy the sizing and selection criteria for regional treatment control BMPs described in the County of Orange Model Water Quality Management Plan (WQMP) (County of Orange, 2003).

## **1.1 Regional Approach for Treatment Control BMPs**

Regional or watershed management programs that address runoff from new development and significant redevelopment are encouraged as alternatives to Project WQMPs within the Santa Ana Regional Board permit area. Regional or watershed programs are meant to provide comprehensive water quality solutions for new development, as well as, providing opportunities to address other watershed needs and runoff from existing developed areas (County of Orange, 2003). Regional management programs must satisfy the following criteria as described in the County Model WQMP:

- Regional watershed management programs must incorporate all routine Source Control BMPs and Site Design BMPs identified in the Regional Plan or determined to be appropriate for the individual projects participating in the plan.
- Regional or watershed treatment control BMPs must be sized such that the collective capacity of the facilities treat more than the cumulative volume (or flow rate) of runoff from all new development or significant redevelopment projects included in the regional or watershed plan, calculated using the applicable project-based water quality volume or flow rate from each project.
- Treatment control BMPs must be selected to address the pollutants of concern in the downstream receiving waters and anticipated to be generated from the type of new development or significant redevelopment in accordance with the selection procedures described in the Model WQMP.
- Regional watershed programs designed for areas with impaired waterbodies and/or watersheds subject to Total Maximum Daily Loads are required to address the requirements of any adopted TMDLs.

## **1.2 Natural Treatment System Plan for Regional Treatment Control BMPs**

The San Diego Creek Natural Treatment System (NTS) Master Plan, developed by the Irvine Ranch Water District (IRWD), is a comprehensive project addressing regional water quality in the San Diego Creek Watershed (IRWD, 2003). The Plan is intended to

serve as a regional treatment component in the watershed-wide BMP program for compliance with loading restrictions (TMDLs). The concept is to create a network of constructed wetlands to treat dry weather base flows and runoff from small storm events. This strategy builds on the local success of the IRWD treatment wetlands in the San Joaquin Marsh. This regional treatment system includes facilities that address existing runoff as well as identified new development facilities that have been comprehensively designed and evaluated to address the treatment requirement in the WQMP for those areas draining to these facilities as well as to assist in meeting TMDL requirements. These facilities would not result in full compliance with WQMPs, as there are significant source and site planning controls that must also be employed. They have been designed to meet the treatment requirement. One of the primary benefits of this program is that IRWD, a dedicated funded public entity will be responsible for long-term maintenance and operation of the facilities.

### **1.2.1 NTS Plan Elements**

**NTS Sites** – The NTS Plan currently includes 31 sites. The sites are distributed throughout the watershed (Figure 1) and range in size from less than 1 acre up to 55 acres. The NTS facilities are categorized into three general configurations:

- Wetlands that are adjacent to existing stream channels (Off-Line facilities)
- Wetlands established within existing stream channels (In-Line facilities)
- Wetlands that are incorporated within existing and planned flood control detention basins

**NTS Design** – Each NTS facility will be tailored to local conditions and constraints, however, most of the NTS facilities share common design features (see Figure 2). Almost all NTS facilities will have constructed water quality treatment wetlands to treat dry weather runoff. Water levels in the wetlands will be in two general regimes:

1. Shallow water regions 1-2 ft in depth that support the growth of emergent wetland vegetation, primarily cattails and bulrushes. These areas are most effective at removing nutrients, and to a lesser extent metals, pathogens, and toxic compounds.
2. Open water regions typically 4-6 ft deep are intended to help distribute the flow uniformly through the wetland vegetation and to trap coarse sediments. These areas are effective at removing sediments and pollutants associated with sediments. Open water areas also facilitate destruction of pathogens.

Many of the NTS facilities will be constructed within stormwater detention basins to detain and treat stormwater runoff (see Figure 2). The depth of the stormwater quality pool is typically 3-4 ft above the normal low flow water level, inundating the wetland vegetation. Removal of pollutants from storm runoff will mainly occur by settling

processes. The primary pollutants removed from storm runoff are sediments and pollutants associated with sediments such as phosphorus, metals, and organic compounds.

**Maintenance** – Maintenance activities will include trash and debris removal, pump servicing, vegetation removal and planting, sediment removal, installation and removal of seasonal weirs, vector control activities, and emergency repairs. To obtain assurances that operation, maintenance, and monitoring activities can be conducted without incurring a “taking” under the Endangered Species Act, IRWD has proposed a major amendment to the Natural Communities Conservation Plan (NCCP).

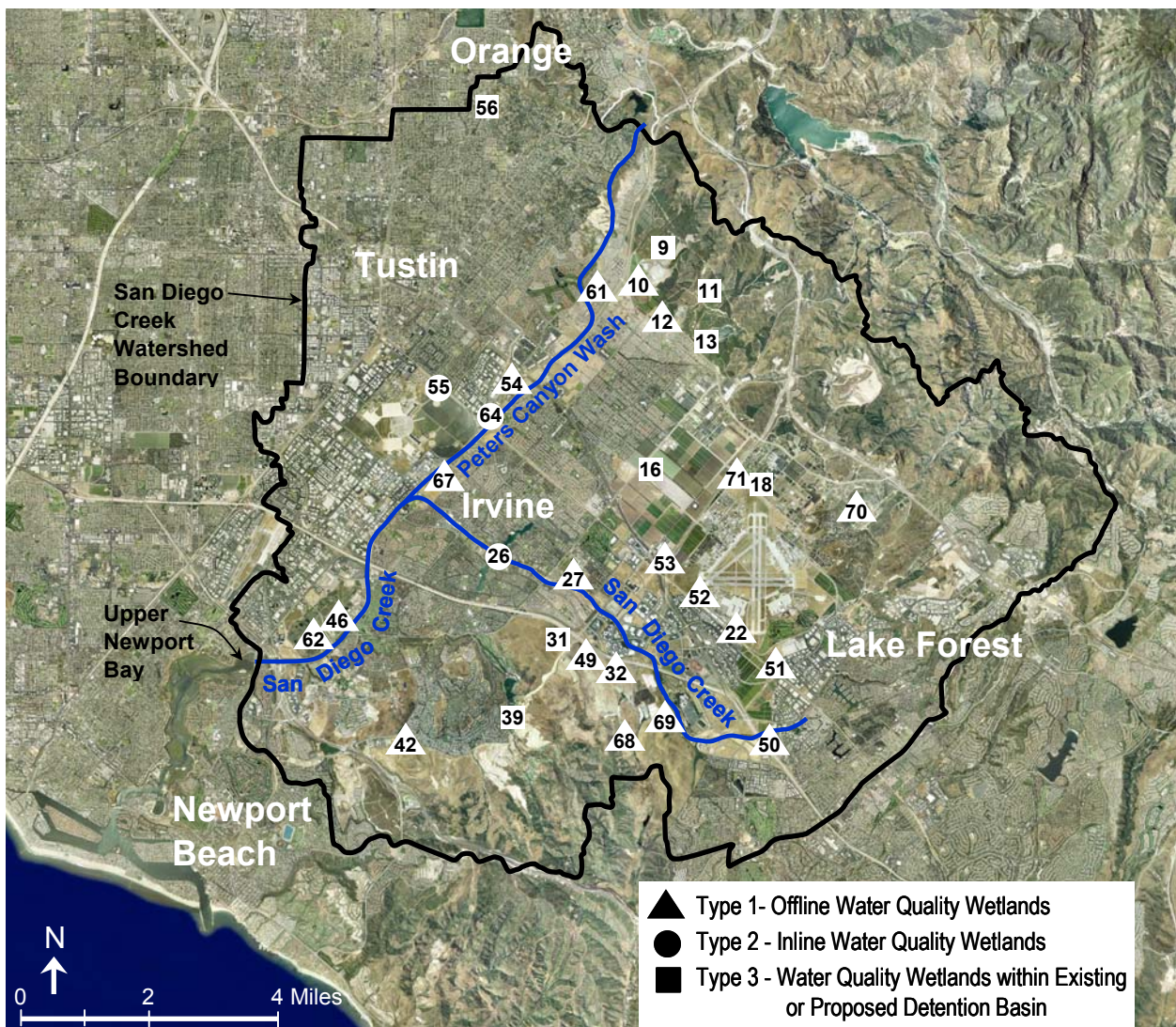
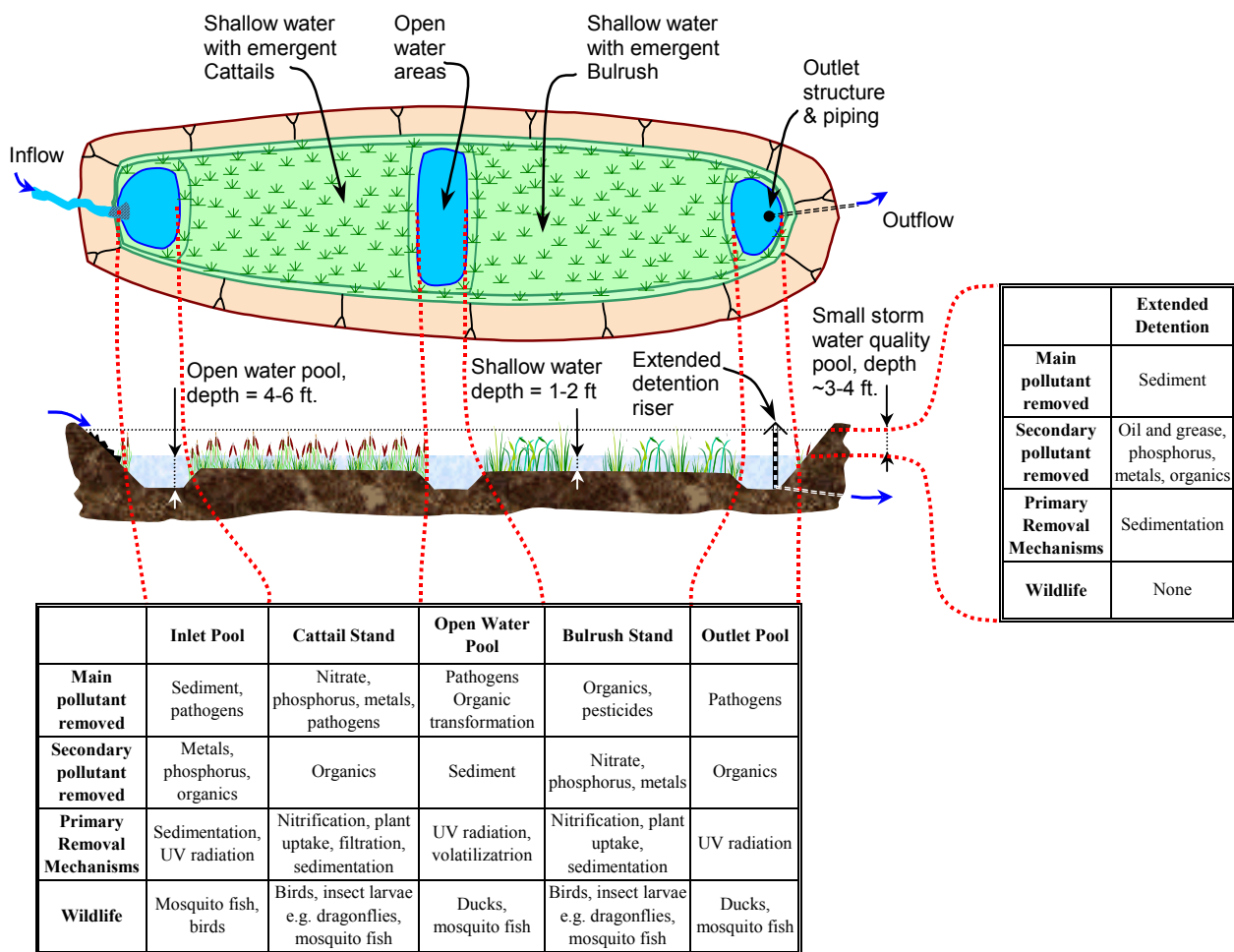


Figure 1: NTS Facility Locations.





**Figure 2: Generic Design of NTS Facilities**

**Monitoring** – Monitoring is a key component of the NTS Plan. Routine monitoring for all sites will include general site inspections, sediment accumulation monitoring, vegetation monitoring, monitoring of pollutant accumulation and distribution, and vector pest monitoring. Detailed performance monitoring will be conducted for a few NTS facilities to evaluate their treatment effectiveness and operating constraints.

**Vector Control** – A comprehensive vector control plan was developed and is included in the NTS Master Plan (IRWD, 2003). Orange County Vector Control will be responsible for implementing the plan.

### 1.2.2 General Treatment Effectiveness of NTS Facilities

Because many of the TMDLs are applicable to dry weather discharges (e.g. nitrogen, metals, pathogens, selenium), the NTS Plan was designed to address both dry-weather

and wet-weather runoff. All NTS facilities serving the Irvine Development Areas will treat both dry-weather and wet-weather runoff. Comprehensive treatment of dry weather flows is one of the significant benefits of the NTS program over individual project compliance with the WQMP.

NTS facilities that integrate water quality treatment wetlands into stormwater detention basins are expected to provide a higher level of treatment than stormwater detention facilities alone, for two reasons:

- ***Dry Weather Treatment.*** The integrated NTS facilities will treat dry weather runoff, which would otherwise be untreated by the single purpose stormwater detention basin. Many of the TMDLs are applicable to dry weather discharges (e.g. nitrogen, metals, pathogens, selenium).
- ***More Effective Stormwater Treatment.*** Stormwater detention basins that include permanent pools and/or vegetation are expected to provide greater levels of pollutant removal than dry and/or un-vegetated basins. This is supported by effluent quality data (see Table 1) for detention basins, wet ponds, and wetlands obtained from the ASCE/EPA Nationwide BMP Database (ASCE, 2001). Table 7-II-6 in the Model WQMP (County of Orange, 2003) similarly indicates that wet ponds and wetlands are more effective than detention basins.

**Table 1: Median Stormwater Effluent Concentrations of Selected BMPs**

Parameter	Units	Retention (Wet) Ponds		Detention Basins		Wetlands**	
		*Water Quality Basin Outflow Concentration	Number of samples	Water Quality Basin Outflow Concentration	Number of samples	Water Quality Basin Outflow Concentration	Number of samples
TSS	mg/L	17.8	723	8.8	366	8.6	224
Total Nitrogen	mg/L	1.23	271	2.81	38	1.22	351
Total Phosphorus	mg/L	0.17	809	0.2	176	0.1	227
Total Copper	ug/L	5.5	575	20	118	3.0	88
Dissolved Copper	ug/L	4.0	306	14	73	6.5	7
Total Lead	ug/L	5.0	790	15	113	1.0	22
Total Zinc	ug/L	29.0	612	94	143	16.3	99
Dissolved Zinc	ug/L	15	243	63	73	15.2	7
Fecal Coliform	MPN/100mL	1600	19	900	24	23.0	5

\* Estimates based on data from the National Stormwater Best Management Practices Database outflow concentration data; the median values of outflow data from all available studies for each of the BMPs were used to provide estimates of BMP performance.

\*\* Effluent data from wetlands in the BMP database are limited. Therefore, comparisons are not conclusive. The limited data suggest that wetland performance is better than the other two BMPs for nearly all constituents.



## **2 Assessment Approach**

The proposed NTS facilities serving Irvine Development Areas were evaluated to determine if they satisfy the sizing and selection criteria of Regional Treatment BMPs. The following describes the assessment approach.

### **2.1 Assessment Approach for Regional BMP Sizing**

The sizing criteria for Regional Treatment BMPs in the model WQMP states that the BMPs must be sized such that the collective capacity of the facilities will treat more than the cumulative volume (or flow rate) of runoff from all new or significant redevelopment projects, as determined by applicable project based sizing criteria.

The following steps were used to evaluate if the proposed NTS facilities serving Irvine Development Areas satisfy the sizing criteria for Regional Treatment BMPs:

1. The required treatment volume for project-based treatment BMPs was determined for all Irvine Development Areas. The criteria used to size the project-based treatment BMPs were obtained from the Model WQMP and are described in Section 2.1.1 below.
2. The required volume of the project based BMPs were summed for all development project areas within City of Irvine Planning Areas. The planning areas evaluated were PA 1, 6, 18, 39, and the El Toro Marine Corps Air Station Redevelopment area.
3. The collective treatment capacity of the proposed NTS facilities was calculated for each of the PAs and the El Toro Redevelopment Area.
4. The proposed NTS facilities were determined to satisfy the sizing criteria for regional treatment BMPs if their collective treatment capacity was greater than the cumulative volume of the project-based BMPs otherwise required within the respective individual PAs and the El Toro Redevelopment Area.

#### **2.1.1 Approach Used to Size Project-Based Treatment BMPs**

The Model WQMP defines two types of sizing criteria for project-based treatment BMPs, one for volume-based BMPs and one for flow-based BMPs. Because the intended Regional Treatment BMPs are NTS facilities comprised of integrated treatment wetlands and stormwater detention basins, the volume based sizing criteria are the applicable sizing criteria and were therefore used to evaluate the treatment requirements for the Irvine Development Areas.

Attachment 1 to the Model WQMP describes four options for calculating the Stormwater Quality Design Storm Volume (SQDV) for the local project watersheds. Method 1 was

used in this assessment because it is the simplest and most straightforward method of the four accepted methods, as it requires the least amount of interpretation in determining rainfall depths.

Method 1 is based on the 24-hour, 85<sup>th</sup> percentile storm event, calculated from the local historic rainfall record. The steps for Method 1 used in this assessment are as follows:

1. Determine the watershed area of the proposed development project. The watershed areas were determined from information provided by landowner and the City of Irvine.
2. Determine the impervious area within the watershed. To enable a consistent approach, the built-out land-use coverage developed for the NTS Master Plan was used. These land-use projections are based on general zoning information. It is expected that the zoning based land-use projections are over-estimates of future development because not all of the zoned area is likely to be fully developed at the potential densities. The impervious area of each land-use type was calculated by multiplying the area of the land-use (determined from GIS maps) by the impervious coverage of the land-use category (see Table 2). The total watershed impervious area was calculated as the sum of impervious areas for each land-use type.

**Table 2: Percent Impervious Coverage for Land Use Categories**

Land Use	Percent Impervious Coverage
Natural or Agriculture <sup>1</sup>	0
Public Park <sup>1</sup>	15
School <sup>1</sup>	40
Low Density Residential (3-4 dwellings/acre) <sup>1</sup>	40
Medium Density Residential (8-10 dwellings/acre) <sup>1</sup>	60
High Density Residential – Apartments <sup>1</sup>	80
Commercial, Downtown Business or Industrial <sup>1</sup>	90
Roads <sup>2</sup>	100
Mixed Use <sup>2</sup>	70

1 - recommended value from Figure C-4 in the Orange County Hydrology Manual (1986)

2 - Assumed value

3. The runoff coefficient of the watershed was calculated with the expression:

$$C = (0.75) * \text{Imp} + 0.15 \quad (\text{Eq. 1})$$

where C represents the runoff coefficient, and Imp represents the impervious area calculated in step 2. Runoff coefficients calculated with this expression are equivalent to values given in Table A-1 of the Model WQMP.

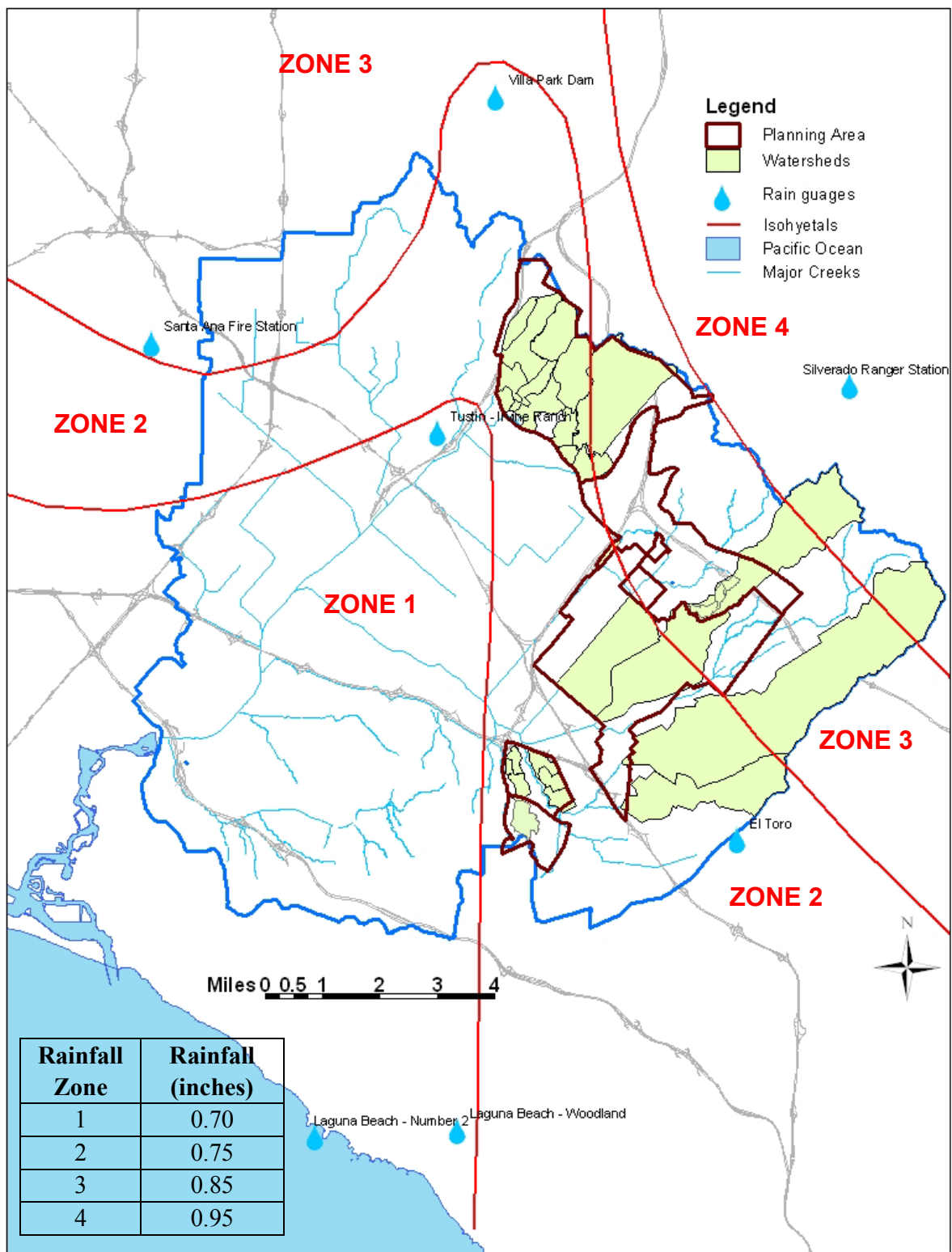
4. Determine the 85<sup>th</sup> percentile rainfall depth for the project area from isohyetal lines shown in Figure A-1 of the Model WQMP. There are four countywide

rainfall zones indicated in Figure A-1. This figure, however, does not provide sufficient detail to indicate the relation of the isohyetal lines to local project areas. To assist in determining the correct rainfall zone for specific project areas, the isohyetal lines shown in Figure A-1 of the Model WQMP were drawn on a map of San Diego Creek Watershed using the location of the rainfall gauging stations as a guide. The resulting map in Figure 3 was used to determine the rainfall zone for each project area. In cases where project watershed areas span more than one rainfall zone, the higher rainfall zone (greater rainfall depth) was selected.

5. Calculate the required water quality design volume of the project treatment BMP using the equation:

$$V_b \text{ (acre-ft)} = C * I \text{ (in)} * A \text{ (acre)} * (1/12) \text{ (ft/in)} \quad (\text{Eq. 2})$$

where  $V_b$  represents the required treatment volume,  $C$  is the runoff coefficient calculated in step 3,  $I$  represents the 85<sup>th</sup> percentile rainfall depth determined in step 4, and  $A$  is the watershed area determined in step 1.



**Figure 3: 24-hour, 85th Percentile Rainfall Zones in the San Diego Creek Watershed**

## 2.2 Assessment of Regional BMP Selection Criteria

The Model WQMP states that Regional Treatment BMPs must be selected to address the pollutants of concern that are anticipated to be generated from new development or significant redevelopment. The pollutants of concern based on land-use in the proposed development areas. They were identified using Table 7.II-2 in the Model WQMP and are summarized in Table 3.

A second selection criterion in the Model WQMP states that Regional Watershed Programs designed for areas subject to TMDLs must address the requirements of any adopted TMDLs. The NTS Plan is a Regional Watershed Program that was specifically designed to contribute to reductions of TMDL constituents in the impaired waterbodies. Therefore, the NTS Plan facilities satisfy the second selection criterion.

The TMDL constituents for the San Diego Creek and Upper Newport Bay Watershed are included in Table 3. Comparisons in Table 3 show that the majority of project based anticipated or potential pollutants of concern are also TMDL constituents. The three exceptions (trash & debris, oxygen demanding substances, and oil & grease) are considered anticipated or potential pollutants of concern for nearly all land-use types. Selenium is a TMDL constituent addressed by the NTS Plan that is not a project-based pollutant of concern because urban development is not considered a major source of selenium in the San Diego Creek Watershed. Table 3 indicates that Regional Treatment BMPs in the San Diego Creek Watershed (along with site planning and source controls) must address all constituents to satisfy the selection criteria requiring treatment of both project-based pollutants of concern and TMDL constituents.

**Table 3: Pollutants of Concern for Development Types and TMDL Constituents**

Constituent	Project Based Anticipated or Potential Pollutant of Concern <sup>1</sup>	TMDL Constituent
TSS	Res, C, Hill, P, T	Yes
Nutrients (N and P)	Res, C, Hill, P, T	Yes
Heavy Metals	C, P, T	Yes*
Bacteria/Virus	Res, C, Hill, P, T	Yes
Pesticides	Res, C, Hill, P, T	Yes*
Organic Compounds	Res, C, Hill, P, T	Yes*
Trash & Debris	Res, C, Hill, P, T	No
Oxygen Demanding Substances	Res, C, Hill, P, T	No
Oil & Grease	Res, C, Hill, P, T	No
Selenium		Yes*

(1) from Table 7.11-2 in the Model WQMP

Development Types:

Res = detached or attached residential development

C = commercial/industrial (including automotive and restaurants)

Hill = Hillside development

P = Parking lots

T = transportation

\* The toxics TMDL for San Diego Creek defines allocations for organophosphate pesticides (diazinon, chlorpyrifos), selenium, cadmium copper, lead, zinc, organochlorine compounds, chromium, and mercury

Quantitative and qualitative assessments of treatment performance by the NTS Plan facilities were conducted as part of the NTS Master Plan development (for details see IRWD, 2003). While the removal effectiveness for some constituents was not fully assessed due to lack of statistically valid monitoring data, the assessments summarized below generally indicate that the NTS Plan facilities will address and contribute to effective, and in some cases, superior levels of treatment for all constituents in Table 3. Thus, the NTS Plan facilities satisfy the selection criteria for Regional Treatment BMPs.

### **2.2.1 Summary of Quantitative and Qualitative Treatment Performance of NTS Facilities**

The following summarizes quantitative and qualitative assessments of treatment performance by the proposed NTS facilities.

**Total Nitrogen.** Total Nitrogen (TN) is a TMDL constituent subject to discharge limitations during dry weather low flows, and is also an anticipated pollutant of concern in storm runoff from most development types. Planning-level water quality models were used to quantify wet weather and dry weather load reductions in the proposed NTS facilities. Results indicate that a fully implemented Regional NTS would remove more than 200,000 lbs of TN annually from dry weather discharges to Newport Bay. Results also show that the NTS Plan facilities would remove almost 20,000 lbs of TN annually from stormwater runoff.

**Sediments.** While estimated annual sediment loads are variable and strongly dependent on rainfall, the modeling results indicate that the NTS Plan facilities would remove, on average, about 800 tons of sediment per year from urban and open space land sources. These removal volumes are most significant in local watersheds served by NTS facilities.

**Total Phosphorus.** Total Phosphorus (TP) in all flow regimes is subject to annual loading restrictions. The vast majority of TP loads are associated with sediment loads from winter storms. The NTS Plan is estimated to remove about 4,300 lbs of TP/year from urban and open land sources for average rainfall conditions.

**Heavy Metals.** Concentration based TMDLs for heavy metals are applicable in all flow regimes. Quantitative assessment of metal removals from stormwater indicates the NTS Plan would remove, on average, about 430 lbs total copper, 130 lbs total lead, and 2300 lbs total zinc. The removal volumes will be most significant in local watersheds served by NTS facilities.

Removal of heavy metals from dry weather flows was not quantified. Available monitoring information from the treatment wetlands at the San Joaquin Marsh indicates that all surface flow wetlands will contribute to removal of heavy metals from dry

weather discharge. Monitoring information from the San Joaquin Marsh indicates removals of up to 27%. These removals are lower due to the relatively low dry weather concentrations.

***Fecal Coliform.*** Fecal coliform indicators of human pathogens are subject to loading limits during all flow regimes. Planning-level water quality models were used to quantify wet weather and dry weather load reductions in the proposed NTS facilities. Results suggest that the NTS Plan would reduce average maximum fecal coliform concentrations of about 25% in dry weather discharge to Upper Newport Bay. Modeling results indicate that the NTS would reduce fecal coliform levels in stormwater on a watershed basis by about 10%.

***Pesticides.*** Concentration based TMDLs for organophosphate pesticides (diazinon & chlorpyrifos) are applicable in all flow regimes. The removal of these compounds in NTS facilities was not quantified. Available monitoring information from the treatment wetlands at San Joaquin Marsh suggests that NTS facilities will contribute to removal of diazinon from dry weather flows. The characteristics of chlorpyrifos suggest that this compound is similarly amenable to treatment in NTS facilities.

***Organic Compounds.*** TMDLs have been developed for legacy organochlorine compounds. Removals of these compounds were not quantified because the ongoing sources of these chemicals are not known. These compounds are strongly associated with sediments and any sedimentation in NTS facilities could provide treatment of these compounds.

The general treatment effectiveness of organic compounds is compound specific. In general organic compounds tend to adsorb to soil particles and most are biodegradable. The proposed NTS facilities using a combination of detention basins and wetlands are expected to be effective at treating compounds through settling, adsorption, and biologically mediated processes.

***Trash & Debris.*** Removals of trash & debris was not numerically quantified as part of the NTS Plan assessment. While urban development is expected to increase trash & debris in stormwater, the proposed NTS water quality basins have been designed to be effective at trapping trash & debris in stormwater. The proposed NTS facilities in combination with required WQMP source control BMPs would provide effective treatment of trash and debris.

***Oxygen Demanding Substances.*** Removal of oxygen demanding substances was not numerically quantified as part of the NTS Plan. Potential oxygen demanding substances in stormwater include animal wastes, food wastes, leaves and twigs, and degradable hydrocarbons. The proposed NTS facilities are effective at trapping and treating these



compounds. Thus, the required WQMP source control BMPs along with the NTS facilities would provide effective treatment of these constituents in stormwater.

***Oil & Grease.*** Removal of oil & grease was not numerically quantified as part of the NTS Plan. Oil & grease tends to adsorb to sediments, have the potential to volatilize, and most forms are biodegradable. Thus, the removal processes in the proposed NTS facilities together with the required WQMP source control BMPs would be effective at treating oil & grease in wet and dry weather runoff.

***Selenium.*** The NTS Plan specifically addresses selenium treatment through the construction of a proposed subsurface treatment wetland(s). This wetland(s) is estimated to remove up 200 lbs of selenium, or about 20-50% of the selenium loads in dry weather discharge to Upper Newport Bay.

### 3 Assessment by Planning Area

This section includes an assessment of the sizing of NTS facilities vs. the WQMP sizing requirements to demonstrate that the NTS program would meet the WQMP Regional Treatment requirements. This assessment has been completed for Irvine Planning Areas 1, 6, 18, 39 and the El Toro Reuse Area.

#### 3.1 Planning Area 1

##### 3.1.1 Proposed NTS Facilities for Regional Treatment in PA 1

A total of 12 NTS facilities are proposed to provide regional water quality treatment for the proposed low-density residential development in PA 1. Figure 4 shows the location and watershed areas of the proposed NTS facilities. Projected land-use in each of the NTS watersheds is shown in Figure 5.

Figure 4. PA-1 Watersheds and NTS Sites

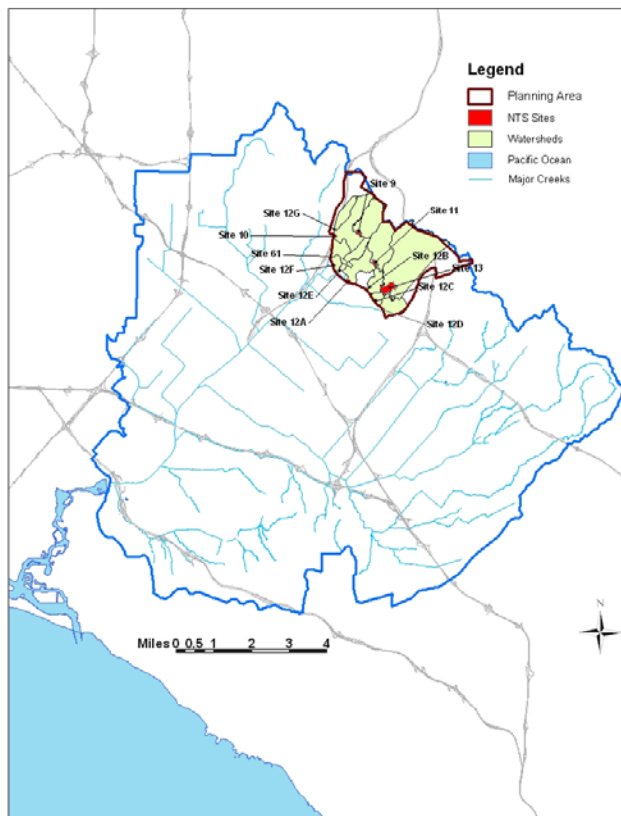
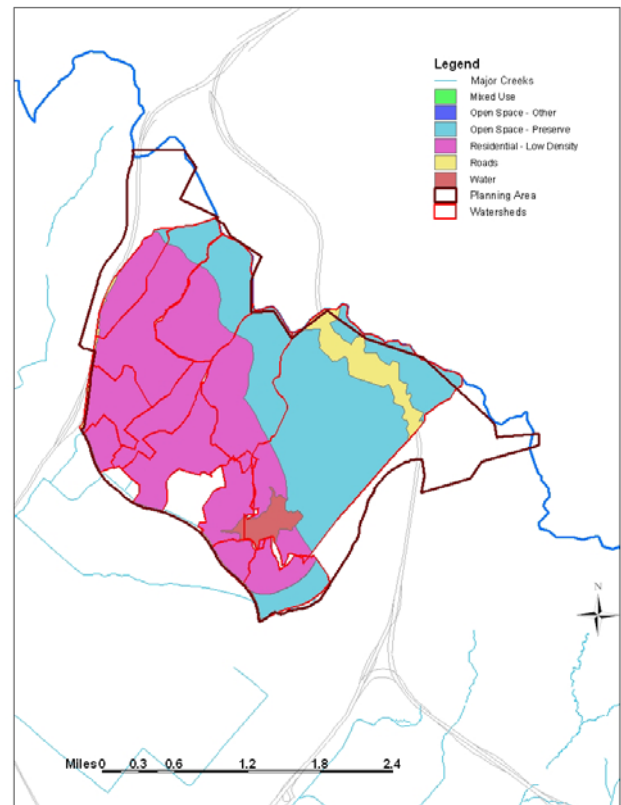


Figure 5. PA-1 Land Use at Build-Out



The following describes the proposed NTS facilities in PA 1.

***NTS Site 9 - Eastfoot Retarding Basin.*** The Eastfoot Retarding Basin is multi-purpose water quality treatment and flood control basin that is currently planned for construction. A water quality pool and extended detention riser outlet structure would provide water quality treatment of stormwater. A constructed wetland would be integrated into the floor of the basin to provide water quality treatment of dry weather runoff from proposed development. A concept of the proposed NTS facility is shown in Figure 6 below.

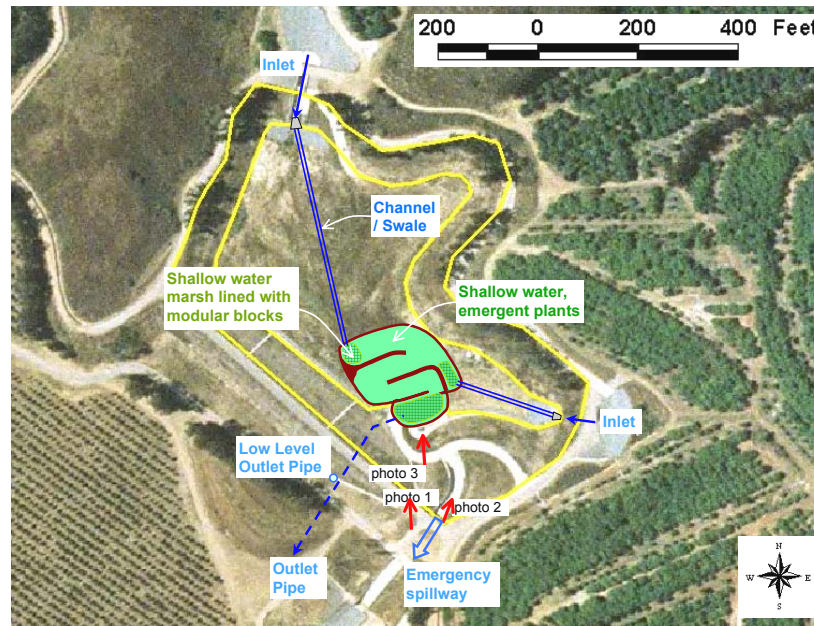


**Figure 6: Conceptual Design of NTS Facilities in the Eastfoot Retarding Basin**

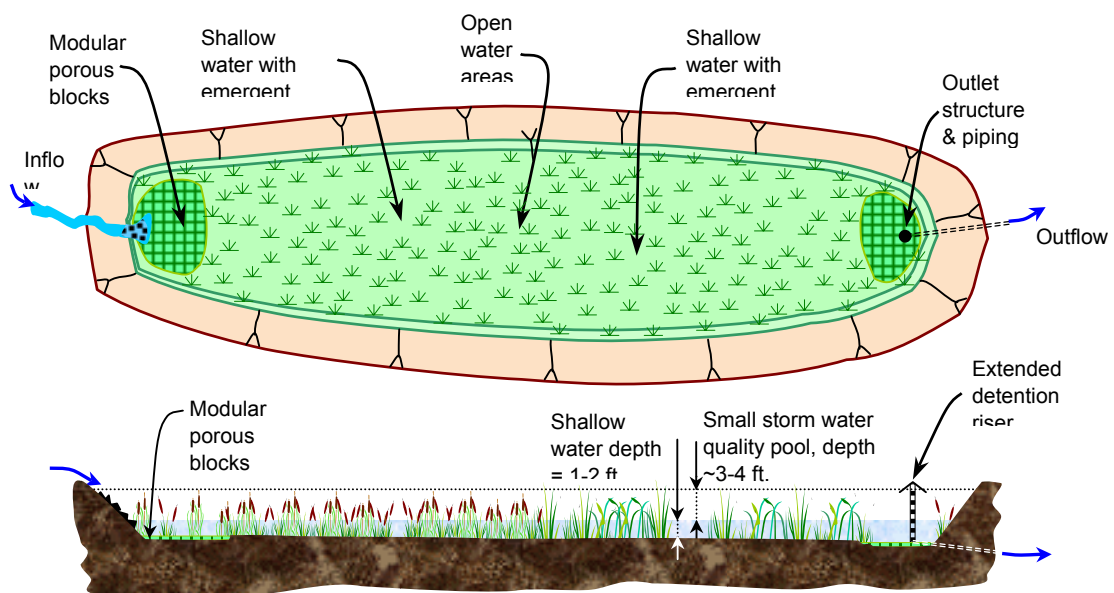
***NTS Site 11 - Orchard Estates Retarding Basin.*** The Orchard Estates Retarding Basin is an existing retarding basin owned by The Irvine Company. Under the proposed NTS Plan the retarding basin would be retrofit to provide wet weather and dry weather water quality treatment. The floor of the basin would be excavated to add a water quality pool and an extended detention riser would be constructed to provide stormwater treatment for a 48-hour detention period. A constructed wetland would be integrated into the floor of the basin to provide water quality treatment of dry weather runoff from proposed development. A concept of proposed NTS facility is shown in Figure 7.

***NTS Sites 10, 12A-12G, & 61 – PA 1 Type I Facilities.*** There are nine proposed Type I NTS facilities for regional treatment of the proposed development in PA 1. Each of these facilities includes constructed wetlands integrated into stormwater detention basins for

the water quality treatment of dry and wet weather runoff from the proposed development area. Design of the facilities has not been completed. While each site will be tailored to local conditions and constraints, a generic design of the facilities is shown in Figure 8.



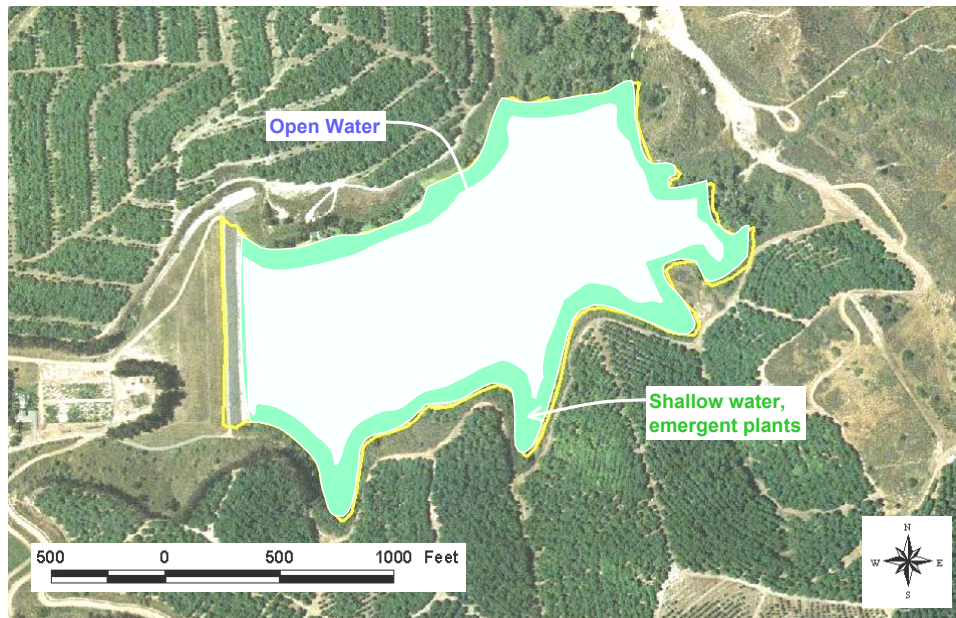
**Figure 7: Conceptual Design of NTS Facilities in the Orchard Estates Retarding Basin**



**Figure 8: Generic Design of Type I NTS Facilities for Regional Treatment in PA 1**



**NTS Site 13 – Rattlesnake Reservoir.** Rattlesnake Reservoir is an existing reservoir that formerly was used to supply water for agricultural irrigation. Currently the reservoir is a reclaimed water storage reservoir owned and operated by IRWD. Portions of proposed development areas will drain to this terminal reservoir. The reservoir retains and thereby effectively treats most dry and wet weather flows. An aerial photo of the reservoir is shown in Figure 9 below.



**Figure 9: Aerial Photo of Rattlesnake Reservoir**

### **3.1.2 Assessment of Sizing Requirements for Regional Treatment BMPs in PA 1**

The approach described in Section 2 was used to evaluate the sizing requirements for regional treatment BMPs in PA 1. The total required treatment volume for project-based treatment BMPs was first calculated using Method 1 from the Model WQMP, as described above. Results are shown in Table 4. The WQMP required cumulative volume of runoff for water quality treatment is 81.2 acre-feet. This cumulative volume is likely an overestimate of actual required volumes because:

1. Not all of the zoned area is likely to be developed. For example, in watershed 12g, zoning information indicates 116-acres of residential development, whereas, actual proposed development is 47-acres of residential development, with 41 acres of open space and 23 acres of orchards.
2. All land-use in the watershed was included in the sizing calculations; however, runoff from some of the areas may not be included in the final project drainage plan (e.g. these areas may not drain to one of the facilities). For example, the open space areas in watershed 9, 11, 13, and the existing transportation corridor in watershed 12g and 13 were included.

**Table 4: Regional Treatment BMP Sizing Assessment for NTS Facilities in PA 1**

<b>Watershed / NTS Site</b>	<b>Total Drainage Area<sup>1</sup> (Acres)</b>	<b>Impervious Area<sup>2</sup></b>	<b>Runoff Coefficient<sup>3</sup></b>	<b>Rainfall Zone<sup>4</sup></b>	<b>85th Percentile 24hr Rainfall Depth (in)<sup>4</sup></b>	<b>Required Project WQ Treatment Volume (AF)<sup>5</sup></b>	<b>Available NTS Stormwater Treatment Vol. (AF)<sup>6</sup></b>
9	328	22.9%	0.32	2	0.75	6.6	12.3
10	386	33.7%	0.40	2	0.75	9.7	11.6
11	398	21.8%	0.45	2	0.75	7.8	23.1
12a	233	40.5%	0.48	2	0.75	6.6	7.3
12b	144	44.2%	0.48	2	0.75	4.3	6.5
12c	52	44.6%	0.32	2	0.75	1.6	3.6
12d	172	23.4%	0.45	3	0.85	4.0	5.9
12e	137	40.0%	0.46	2	0.75	3.9	4.8
12f	55	42.2%	0.46	2	0.75	1.6	3.3
12g	129	41.2%	0.47	2	0.75	3.7	3.1
61	139	42.6%	0.30	2	0.85	4.1	4.7
13	1256	20.9%	0.43	3	0.75	27.3	Terminal reservoir <sup>7</sup>
<b>Total</b>						<b>81.2</b>	<b>86.2</b>

(1) Area shown in Figure 4

(2) Land-use areas shown in Figure 5. Impervious area by land-use category listed in Table 2.

(3) Runoff coefficient calculated with Eq. 1

(4) Rainfall zone determined from Figure 3

(5) Water quality treatment volume calculated with Eq. 2

(6) Obtained from NTS Master Plan and/or The Irvine Company

(7) Terminal Reservoir not included in cumulative Regional Treatment Volume

The collective wet weather water quality treatment capacity of the proposed NTS facilities is 86.2 acre-ft (Table 4), excluding treatment afforded by drainage into the terminal Rattlesnake Reservoir. Therefore, the collective treatment capacity of proposed NTS facilities in PA 1 exceeds the cumulative project-based treatment volume (81.2 acre-ft) based on WQMP sizing criteria. The proposed NTS facilities in PA 1 satisfy the sizing criteria for regional treatment BMPs.

## **3.2 Planning Area 6**

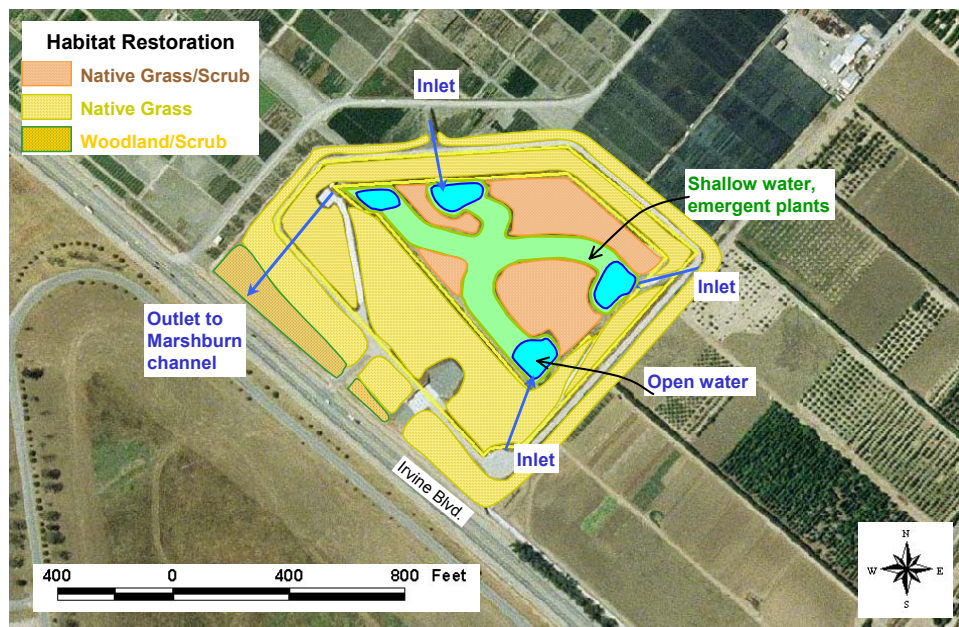
### **3.2.1 Proposed NTS Facilities for Regional Treatment in PA 6**

A total of five NTS facilities are proposed to provide regional water quality treatment for existing and proposed development in PA 6. Figure 11 shows the location and watershed areas of the proposed NTS facilities. Projected land-use within the facility watersheds is shown in Figure 12.

The following describes the proposed NTS facilities in PA 6.

**NTS Site 18 - Marshburn Retarding Basin.** Marshburn Retarding Basin is an existing facility that is operated and maintained by the Orange County Flood Control District as a regional flood control facility. Currently, the tributary drainage area is primarily open space and some agricultural lands. Portions of future residential and commercial developments expected in PA 6 would drain to this basin. The reconfigured basin would also treat runoff from development areas north of PA6.

WQT wetlands are proposed in the bottom of the basin to treat dry and wet season low flows and runoff from small storm events. The wetlands would be integrated into the retarding basin without impacting the flood control functions of the facility. About eight feet would be excavated from the bottom of the basin to create a separate water quality pool and detention area. All inlet and outlet works would be appropriately modified. A concept of the proposed NTS facility is shown in Figure 10.

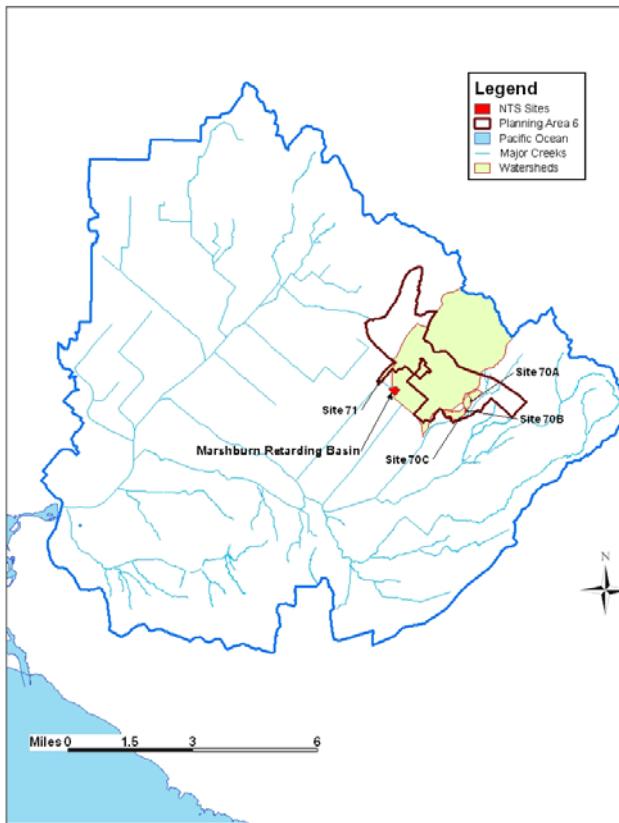


**Figure 10: Conceptual Design of NTS Facilities in the Marshburn Retarding Basin**

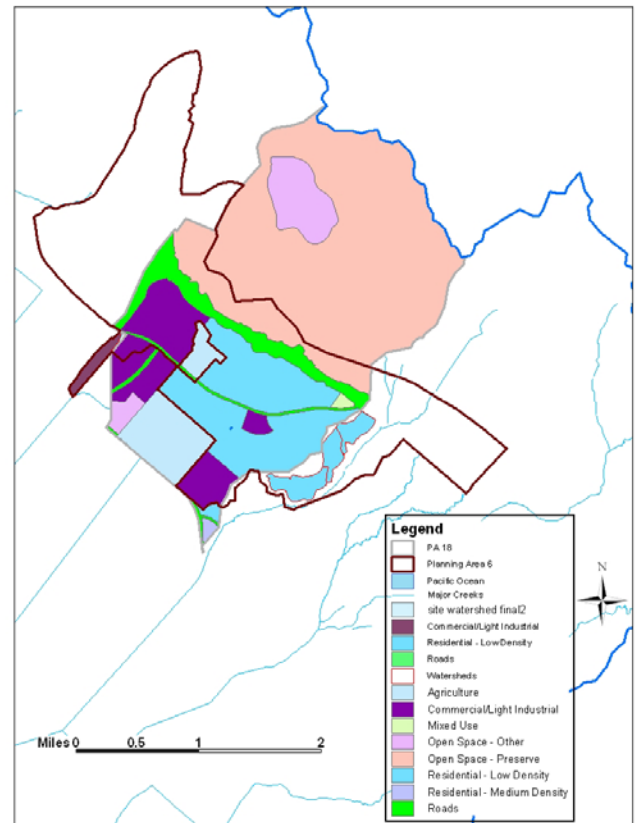
**NTS Sites 70 & 71 - PA 6 Type I Facilities.** Proposed NTS facilities are constructed wetlands integrated into stormwater detention basins for the water quality treatment of dry and wet weather runoff from the proposed development areas. Site 70 would treat proposed low-density residential development, and Site 71 would treat runoff from the existing SR133. Design of the facilities has not been completed and each site will be tailored to local conditions and constraints. A generic design of the facilities is shown in Figure 2.



**Figure 11. PA-6 Watersheds and NTS sites**



**Figure 12. PA-6 Land Use at Build-out**



### 3.2.2 Assessment of Sizing Requirements for Regional Treatment BMPs in PA 6

The approach described in Section 2 was used to evaluate the sizing requirements for regional treatment BMPs in PA 6. Results are shown in Table 5. The cumulative treatment volume for project-based treatment BMPs calculated with Method 1 is 58.5 acre-ft. The collective water quality treatment capacity of the proposed NTS facilities is 85.7 acre-ft. Results in Table 5 show that the collective treatment capacity of proposed NTS facilities in PA 6 exceeds the cumulative volume of runoff for water quality treatment. Therefore, the proposed NTS facilities in PA 6 satisfy the sizing criteria for regional treatment BMPs.

**Table 5: Regional Treatment BMP Sizing Assessment for NTS Facilities in PA 6**

<b>Watershed / NTS Site</b>	<b>Drainage Area<sup>1</sup> (Acres)</b>	<b>Impervious Area<sup>2</sup></b>	<b>Runoff Coefficient<sup>3</sup></b>	<b>Rainfall Zone<sup>4</sup></b>	<b>85th Percentile 24hr Rainfall Depth (in)<sup>4</sup></b>	<b>Required Project WQ Treatment Volume (AF)<sup>5</sup></b>	<b>Available NTS Stormwater Treatment Vol. (AF)<sup>6</sup></b>
18	1418	52%	0.54	3	0.85	54.1	81
70A	20	40%	0.45	3	0.85	0.64	0.71
70B	23	40%	0.45	3	0.85	0.73	0.82
70C	40	40%	0.45	3	0.85	1.28	1.40
71	32	100%	0.90	2	0.75	1.79	1.79
<b>Total</b>						<b>58.5</b>	<b>85.7</b>

- (1) Area shown in Figure 11. Only land-use with PA6 included in calculations  
(2) Land-use areas shown in Figure 12. Impervious area by land-use category listed in Table 2.  
(3) Runoff coefficient calculated with Eq. 1  
(4) Rainfall zone determined from Figure 3  
(5) Water quality treatment volume calculated with Eq. 2  
(6) Obtained from NTS Master Plan and/or The Irvine Company

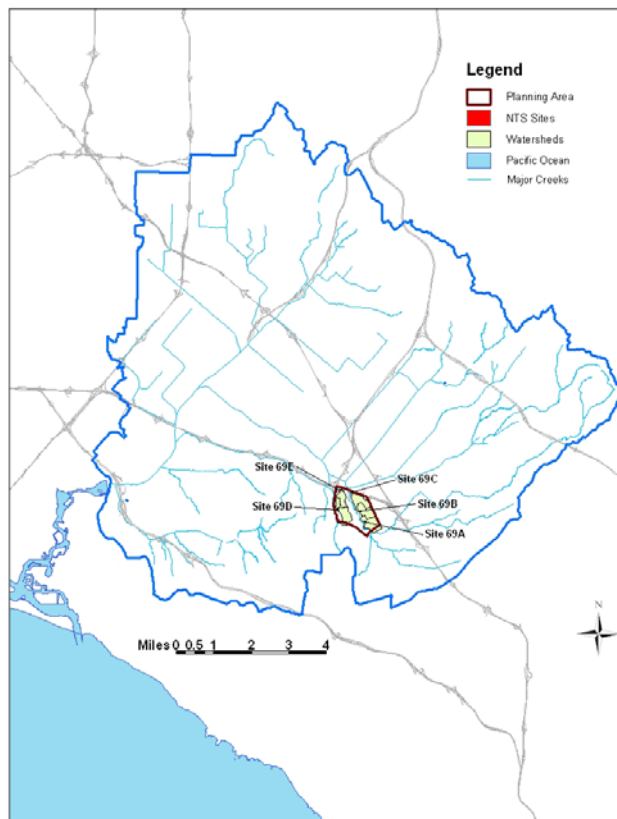
### **3.3 Planning Area 39**

#### **3.3.1 Proposed NTS Facilities for Regional Treatment in PA 39**

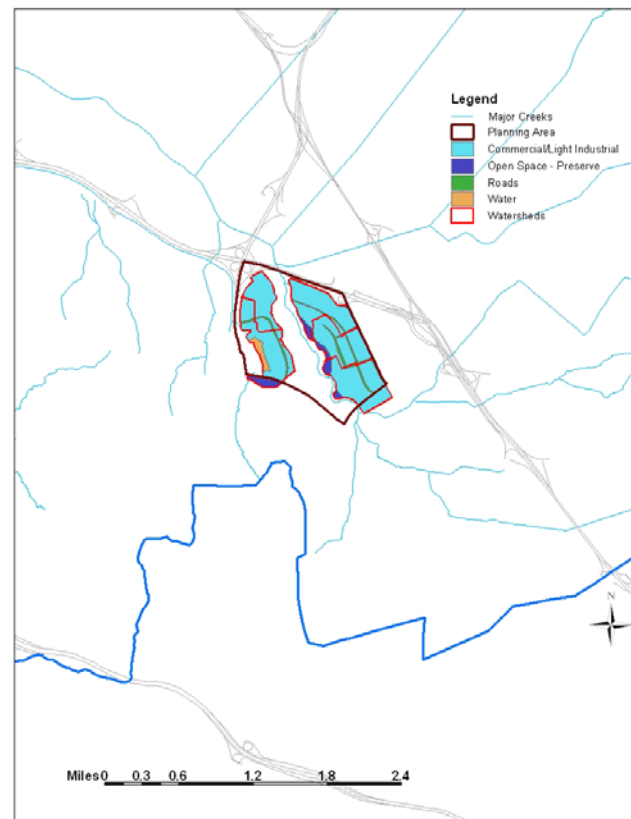
A total of five NTS facilities are proposed to provide regional water quality treatment for existing and proposed development in PA 39. Figure 13 shows the location and watershed areas of the proposed NTS facilities. Projected land-use shown in Figure 14 indicates that the majority of the proposed development area is zoned for commercial development.

The proposed NTS facilities are constructed wetlands integrated into stormwater detention basins for the water quality treatment of dry and wet weather runoff from the proposed development area. Design of the facilities has not been completed and each site will be tailored to local conditions and constraints. A generic design of the facilities is shown in Figure 2.

**Figure 13. PA-39 Watersheds and NTS sites**



**Figure 14. PA-39 Land Use at Build-out**



### 3.3.2 Assessment of Sizing Requirements for Regional Treatment BMPs in PA 39

The approach described in Section 2 was used to evaluate the sizing requirements for regional treatment BMPs in PA 39. Results are summarized in Table 6. The cumulative treatment volume for project-based treatment BMPs calculated with Method 1 is 17.1 acre-ft, and the collective water quality treatment capacity of the proposed NTS facilities is 15.0 acre-ft. These results indicate a shortage in treatment capacity, however, the discrepancy is explained by differences in the land-use assumptions. Sizing of the NTS facilities in the IRWD Master Plan is based on general zoning information, which is similarly used in this assessment for consistency. However, the sizing for the NTS facilities in PA 39 was based on more current and more detailed project level information obtained from the landowner. This information includes less imperviousness. Based upon the current project level information, the WQMP treatment requirement is overstated using the zoning information. Also, final project plans must meet the WQMP requirements and must be approved by the City. Final design of the water quality basins in PA 39 will be consistent with the requirements for regional water quality treatment and will exceed the required WQMP treatment levels.

**Table 6: Regional Treatment BMP Sizing Assessment for NTS Facilities in PA 39**

<b>Watershed / NTS Site</b>	<b>Total Drainage Area<sup>1</sup> (Acres)</b>	<b>Impervious Area<sup>2</sup></b>	<b>Runoff Coefficient<sup>3</sup></b>	<b>Rainfall Zone<sup>4</sup></b>	<b>85th Percentile 24hr Rainfall Depth (in)<sup>4</sup></b>	<b>Required Project WQ Treatment Volume (AF)<sup>5</sup></b>	<b>Available NTS Stormwater Treatment Vol. (AF)<sup>6</sup></b>
69A	72	84%	0.78	2	0.75	3.5	3.3
69B	82	86%	0.79	2	0.75	4.1	3.7
69C	68	85%	0.79	2	0.75	3.4	3.1
69D	75	83%	0.77	2	0.75	3.6	2.8
69E	55	77%	0.73	2	0.75	2.5	2.1
<b>Total</b>						<b>17.1</b>	<b>15.0</b>

(1) Area shown in Figure 13

(2) Land-use areas shown in Figure 14. Impervious area by land-use category listed in Table 2.

(3) Runoff coefficient calculated with Eq. 1

(4) Rainfall zone determined from Figure 3

(5) Water quality treatment volume calculated with Eq. 2

(6) Obtained from NTS Master Plan and/or The Irvine Company

### 3.3.3 Proposed NTS Facilities for Regional Treatment in PA 18

A single NTS facility is proposed to provide regional water quality treatment for the planned low-density residential development in PA 18. Figure 15 shows the location and watershed area of the proposed NTS facility. Projected land-use in each of the NTS watershed is shown in Figure 16.

The proposed NTS facility includes constructed wetlands integrated into stormwater detention basins for the water quality treatment of dry and wet weather runoff from the proposed development area. A generic design of the facility is shown in Figure 2.

### 3.3.4 Assessment of Sizing Requirements for Regional Treatment BMPs in PA 18

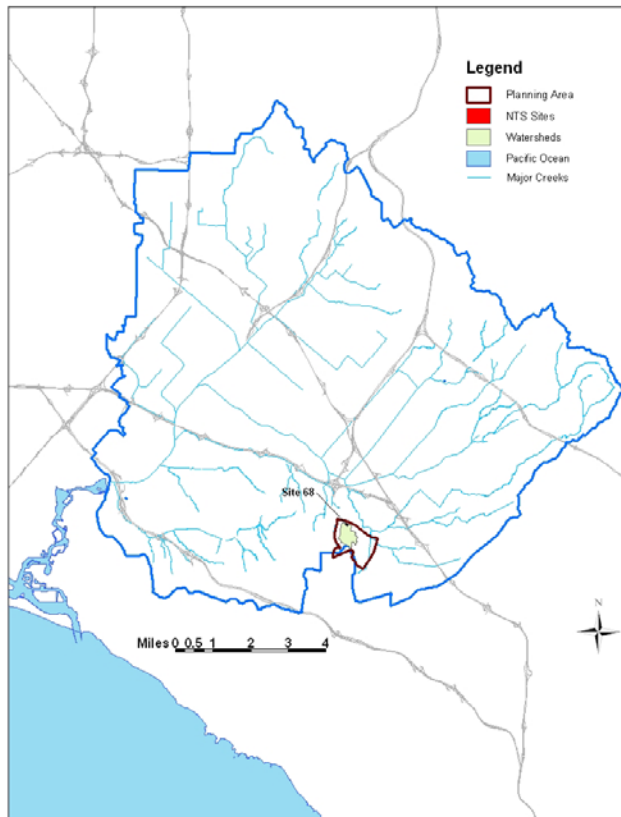
The approach described in Section 2 was used to evaluate the sizing requirements for regional treatment BMPs in PA 18. Results are shown in Table 7. The treatment volume for project-based treatment BMPs calculated with Method 1 is 2.5 acre-ft. The water quality treatment capacity of the proposed NTS facilities is 2.9 acre-ft. Thus, the treatment capacity of proposed NTS facility in PA 18 exceeds the volume of runoff for water quality treatment based on sizing criteria in the WQMP. Therefore, the proposed NTS facility in PA 18 satisfies the sizing criteria for regional treatment BMPs.

**Table 7: Regional Treatment BMP Sizing Assessment for NTS Facilities in PA 18**

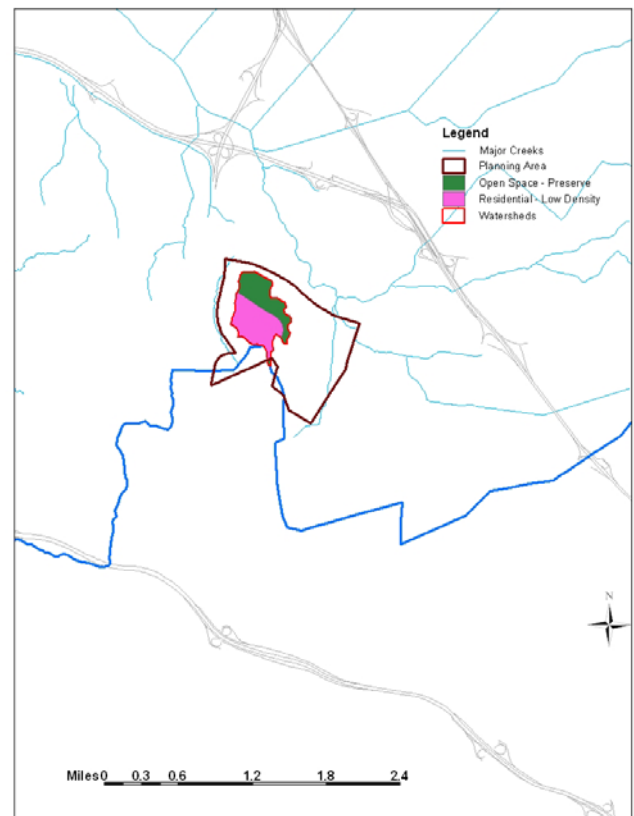
Watershed / NTS Site	Total Drainage Area <sup>1</sup> (Acres)	Impervious Area <sup>2</sup>	Runoff Coefficient <sup>3</sup>	Rainfall Zone <sup>4</sup>	85th Percentile 24hr Rainfall Depth (in) <sup>4</sup>	Required Project WQ Treatment Volume (AF) <sup>5</sup>	Available NTS Stormwater Treatment Vol. (AF) <sup>6</sup>
68	129	22%	0.32	2	0.75	2.5	2.9
<b>Total</b>						<b>2.5</b>	<b>2.9</b>

- (1) Area shown in Figure 13
- (2) Land-use areas shown in Figure 14. Impervious area by land-use category listed in Table 2.
- (3) Runoff coefficient calculated with Eq. 1
- (4) Rainfall zone determined from Figure 3
- (5) Water quality treatment volume calculated with Eq. 2
- (6) Obtained from NTS Master Plan and/or The Irvine Company

**Figure 15. PA-18 Watersheds and NTS Sites**



**Figure 16. PA-18 Land Use at Build-Out**

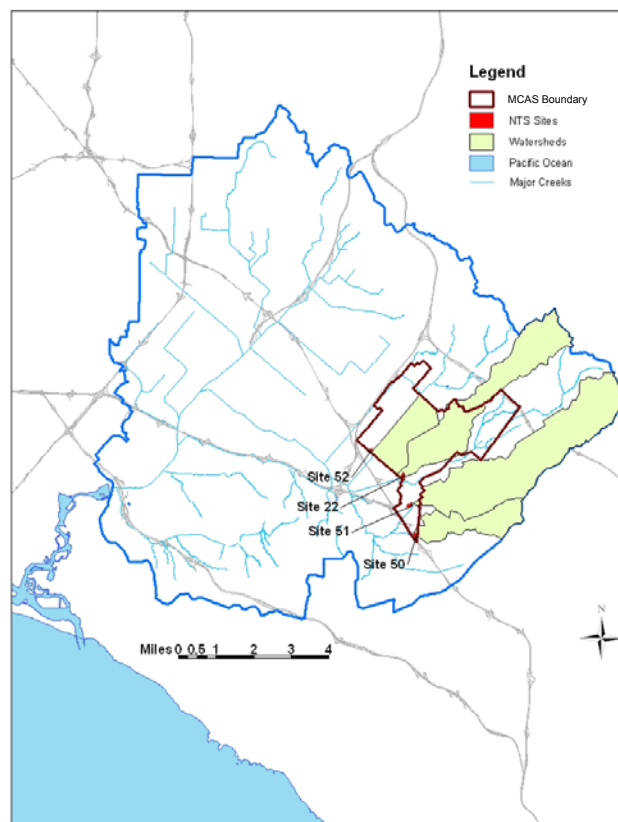


### 3.4 MCAS El Toro Redevelopment Sites

#### 3.4.1 Proposed NTS Facilities for Regional Treatment in MCAS El Toro

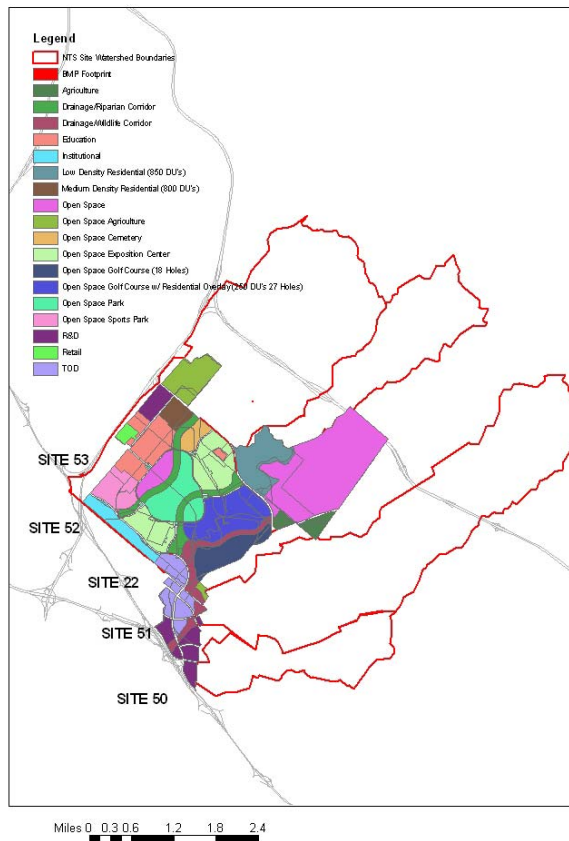
A total of four NTS facilities are proposed to provide regional water quality treatment for existing and proposed development in MCAS El Toro Redevelopment Area. Figure 17 shows the location and watershed areas of the proposed NTS facilities. Notice that large portions of the tributary watersheds are outside the MCAS property. Figure 18 shows the proposed land-use of the Great Parks Redevelopment Plan, and Figure 19 shows the estimated built-out land-use in the watersheds tributary to the proposed NTS facilities. Figure 19 indicates that extensive areas of existing and future development outside the MCAS property would be treated by the proposed NTS facilities.

The proposed NTS facilities are constructed wetlands integrated into stormwater detention basins for water quality treatment of dry and wet weather runoff. Design of the facilities has not been completed and each site will be tailored to local conditions and constraints. A generic design of the facilities is shown in Figure 2.

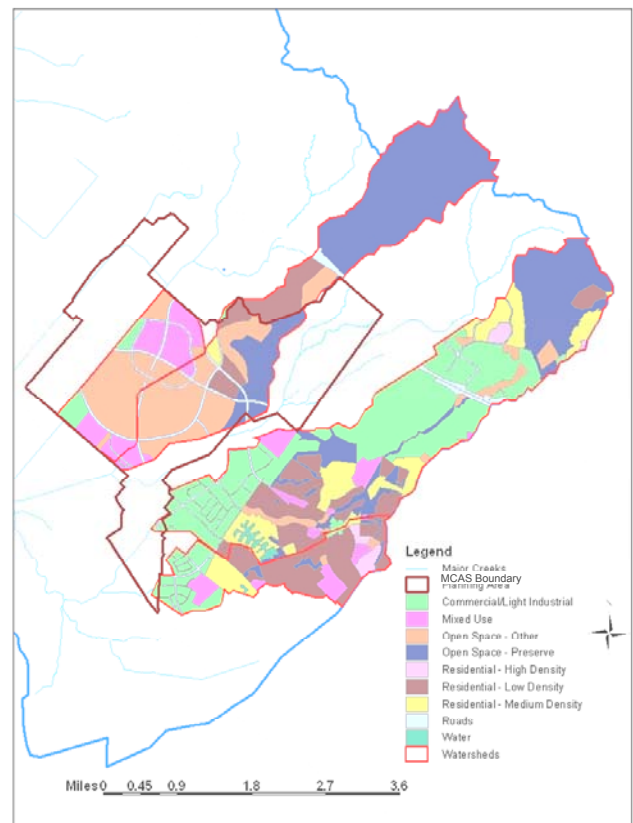


**Figure 17: El Toro Watersheds and NTS Sites**

**Figure 18. Proposed Land-Use in the Great Parks Plan for MCAS El Toro Redevelopment**



**Figure 19. Estimated Built-Out Land-Use from Zoning Information in Areas Tributary to NTS Facilities**



### 3.4.2 Assessment of Sizing Requirements for Regional Treatment BMPs in the MCAS El Toro Redevelopment Area

The approach described in Section 2 was used to evaluate the sizing requirements for regional treatment BMPs in the El Toro Redevelopment Area. Results are shown in Table 8. The cumulative volume of runoff for water quality treatment of proposed development in the Great Parks Plan is 65.4 acre-feet. The collective water quality treatment capacity of the proposed NTS facilities is 115.8 acre-ft. Thus, the collective treatment capacity of proposed NTS facilities in MCAS Redevelopment area exceeds the cumulative volume of runoff for water quality treatment based on the WQMP sizing criteria. Therefore, the proposed NTS facilities satisfy the sizing criteria for regional treatment BMPs.



**Table 8: Regional Treatment BMP Sizing Assessment for NTS Facilities in El Toro  
Redevelopment Area**

<b>Watershed / NTS Site</b>	<b>Total Drainage Area<sup>1</sup> (Acres)</b>	<b>Impervious Area</b>	<b>Runoff Coefficient<sup>3</sup></b>	<b>Rainfall Zone<sup>4</sup></b>	<b>85th Percentile 24hr Rainfall Depth (in)<sup>4</sup></b>	<b>Required volume to treat entire watershed (AF)<sup>5</sup></b>	<b>Required Project WQ Treatment Volume (AF)<sup>5</sup></b>	<b>Available NTS Stormwater Treatment Vol. (AF)<sup>6</sup></b>
22 <sup>2</sup>	2811	12.1%	0.23	3	0.85	47		35.4
50 <sup>2</sup>	1103	53.9%	0.55	2	0.75	38		29.4
51 <sup>2</sup>	4359	53.3%	0.55	3	0.85	170		38.0
52 <sup>2</sup>	986	41.8%	0.46	2	0.75	29		13.0
MCAS Great Parks Plan <sup>7</sup>	3252 <sup>7</sup>	22.9	0.32	2	0.75		65.4	
<b>Total</b>							<b>65.4</b>	<b>115.8</b>

(1) Area shown in Figure 17

(2) Land-use areas shown in Figure 19. Impervious area by land-use category listed in Table 2.

(3) Runoff coefficient calculated with Eq. 1

(4) Rainfall zone determined from Figure 3

(5) Water quality treatment volume calculated with Eq. 2

(6) Obtained from NTS Master Plan and/or The Irvine Company

(7) Area and Land-use of Great Parks Redevelopment Plan shown in Figure 18, exclusive of open space area above Irvine Blvd.

## 4 Summary and Conclusions

This report describes criteria and procedures used to evaluate regional water quality treatment capabilities of the proposed Natural Treatment System (NTS) facilities. The purpose was to determine the extent to which NTS facilities serving the Irvine Development Areas would satisfy the sizing and selection criteria for regional treatment control BMPs described in the County of Orange Model Water Quality Management Plan (WQMP) (County of Orange, 2003).

There are two main selection criteria for Regional Treatment BMPs in the Model WQMP: 1) Regional Treatment BMPs must be selected to address the pollutants of concern that are anticipated to be generated from new development or significant redevelopment, and 2) Regional Watershed Programs designed for areas subject to TMDLs must address the requirements of any adopted TMDLs.

The NTS Plan is a Regional Watershed Program that was specifically designed to contribute to dry and wet weather reductions of TMDL constituents. All NTS Plan facilities serving the Irvine Development Areas consist of water quality treatment wetlands that are integrated into stormwater detention basins. It is expected that this treatment approach will provide better water quality treatment than detention basins alone because: 1) the wetlands will treat dry weather runoff from the development area, and 2) information in the ASCE BMP database indicates that wet ponds and wetlands provide better stormwater effluent quality than traditional dry detention ponds. Quantitative and qualitative analyses presented in the Draft NTS Master Plan Report and summarized in Section 2 of this report indicate that the proposed NTS facilities would provide high levels of treatment for the anticipated and potential constituents of concern from urban development projects. The proposed NTS facilities satisfy the selection criteria for Regional Treatment BMPs in The Model WQMP

The sizing criteria for Regional Treatment BMPs in the Model WQMP states that the BMPs must be sized such that the collective capacity of the facilities will treat more than the cumulative volume (or flow rate) of runoff from all new or significant redevelopment projects, as determined by applicable project based sizing criteria.

The required water quality treatment volume for the Irvine Development Areas were grouped according to the City of Irvine Planning Areas 1, 6, 18, 39, and the MCAS El Toro Redevelopment Area. In all cases, except PA 39, the collective water quality treatment volume of the proposed NTS facilities within the Planning Areas was greater than the calculated cumulative project-based treatment volume required by Method 1 of the Model WQMP. The analyses for PA 39 showed that the NTS facilities would be slightly undersized based on land-use projections from general zoning information, rather

than specific project-level information. It is expected that the final project plans, based on actual proposed land-use, will satisfy the WQMP sizing requirements, and will therefore be consistent with the requirements for regional water quality treatment. Thus the proposed NTS facilities serving the Irvine Development Areas satisfy the sizing criteria for Regional Treatment BMPs in the Model WQMP.

Finally, the NTS plan provides for comprehensive long-term operation, maintenance, monitoring, and vector control by an agency (IRWD) with dedicated funding to assure the long-term success of the facilities in reducing pollution in San Diego Creek, its tributaries, and Upper Newport Bay.

## **5 References**

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